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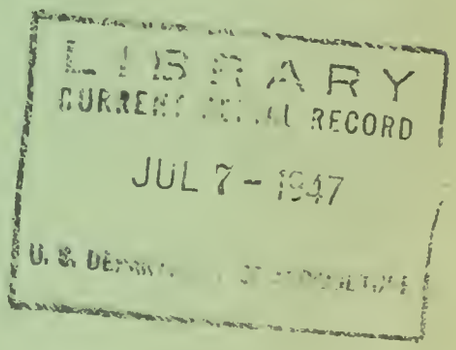

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SOIL CONSERVATION IN THE SOUTHWEST REGION

Miles from highway or village, a unique concrete obelisk near the San Juan River marks the only four-state corner in the Nation. Here Arizona, Utah, Colorado and New Mexico have their common corner. And here is the center of 421,404 square miles of sparsely settled agricultural area with physiography, climate, soil types, land-use patterns and human occupants so varied as almost to defy any but encyclopaedic description.

THE REGION

This is the area which the Soil Conservation Service calls its Southwest Region and within which it has been evolving for some twelve years a program of soil and water conservation. This program is today being carried out by farmers and ranchers within more than 200 soil conservation districts, already embracing better than 106,000,000 acres of privately owned land in these four States.

Besides a common corner, these four States have in common a great and consuming dependence upon grass and irrigation water which makes the word "watershed" here more meaningful, perhaps, than anywhere else in the Nation. Even the dry land farming areas are involved in the watershed relationship because, although not using irrigation water, they often contribute sediment which affects other portions of the watershed.

Within the Southwest Region are the Colorado Basin including the Gila; the Rio Grande and its chief tributary the Pecos; the Rocky Mountains, Wasatch Mountains, Colorado Plateau, Great Basin, and many minor mountains and mesas. The Region has great topographic variety, with rugged mountains, broad plateaus, deep canyons, cliffs, extensive alluvial valleys, bare salt flats and ancient lake sites. Elevations range from more than 14,000 feet above sea level in the Rockies to less than 200 feet in the desert lowlands of southern Arizona.

In general, precipitation increases with elevation, ranging from $3\frac{1}{2}$ inches in the lower Colorado drainage to more than 40 inches in the mountains. Seasonal distribution varies greatly. In most of the Region, precipitation is inadequate to produce satisfactory crops consistently without irrigation. Extreme diurnal temperature variations and excessive heat and cold are typical, with a mean annual temperature of 50° F in the major portion of the Region.

Soil types are as varied as the topography, parent rocks and climate which produced them. Nature's restless forces, abetted by man's activities, have shifted the soil forming materials, but despite the complex environment, rather definite soil areas can be recognized and described.

Soils of the Great Plains are derived largely from Rocky Mountain erosional debris and loess blown from these materials. They are, in general, deep to moderately deep, medium to moderately heavy textured with interspersed areas of sandy soils. The Rocky Mountains, Wasatch, and the high mountainous areas of Arizona and New Mexico have extremely variable soils ranging from very shallow lithasols to deep highly organic mountain valley soils. Soils of the Colorado Plateau and Bonneville Basin belong principally to the northern desert group. Depth varies from shallow to moderately deep and the soils are moderately heavy textured, highly calcareous and often contain saline deposits. The southern extension of the Basin and Range Province is dominated by soils of the southern desert group. They vary, but are generally moderately deep to deep and moderately heavy except in southeastern New Mexico where sandy soils occur.

Throughout the Region, recent alluvial soils occur in the principal river valleys. These are extremely variable in texture and depth and many sections are affected by salts and high water table. Where irrigation is by direct diversion of stream flow, deposition of undesirable sediments and colloidal material often causes the soils to become heavy textured and reduces moisture penetration.

AGRICULTURE AND POPULATION

Although irrigated lands comprise only 2.4 percent of the total land area, 61 percent of all farms and 44 percent of all crop land in this Region were irrigated in 1940. The value of irrigated crops is probably 60 to 75 percent of all crops produced.

The irrigated desert lands are intensively farmed and land values are high. Citrus, cotton, alfalfa and year-round vegetable crops predominate. In the irrigated valleys at higher elevations, potatoes, sugar beets, small grains, alfalfa, tame hay, fruits and vegetables are the main crops. Throughout the Region are hundreds of small valleys where part-time and subsistence farming is predominant. Part-time farming is also common in areas adjacent to the larger cities. These part-time and subsistence areas are often farmed intensively, producing fruits and vegetables.

The greater part of the Region, some 72.5 percent, is used entirely for grazing. Another 22 percent is covered with trees and used primarily for the production of wood products. A large portion of this forest land, however, contains fair stands of grass and is also used for grazing.

The major dry land farming areas are in eastern New Mexico, eastern Colorado and northern Utah, although many smaller areas are spotted through the Region wherever rainfall approaches adequacy. The dry land crop area takes in about 3.1 percent of the total land area, with wheat, sorghums and beans the major crops.

Slightly less than one-fourth of the total population of 2,704,424 was classified as rural farm population in 1940. The larger part of the population is found in the major irrigated areas where intensive farming is practiced, while dry land, range and forest areas are sparsely settled. In Maricopa County, Arizona, largely irrigated land, one-third of the State's total population and also one-third of the rural farm population is concentrated. About 79 percent of the total population and 62 percent of the rural farm population of Colorado live in three irrigated areas--the South Platte, Arkansas and lower Colorado and Gunnison River valleys, about one-third the State's total area. The same pattern prevails in Utah, where about 59 percent of the State's total population and 30 percent of the rural farm population reside in Salt Lake, Weber and Utah counties, an area with large irrigated acreage and comprising 4 percent of the State. In New Mexico, also, most of the people live within irrigated areas such as the Rio Grande, Pecos, San Juan and Upper South Canadian valleys.

HISTORICAL INFLUENCES

Indians were the Region's first farmers, located for the most part in the main river valleys where Spanish explorers found them using primitive irrigation methods. The Spanish, bringing with them a background of irrigation settled and began to farm, improving on the crude Indian methods. These two groups were the Region's only agriculturalists when the Mormons entered Utah in 1847. The Mormons, in turn, developed irrigation farming. Modern irrigation began in Arizona, Colorado, and New Mexico in the late 1850's and has made rapid progress, particularly after many of the large projects were opened up with aid under the Reclamation Act of 1903.

The earliest Spanish settlers brought livestock into the Region, but it remained for the last twenty years of the 19th century to witness the great expansion in cattle and sheep, declining again in the first years of this century. In the prairies east of the Rockies there was an early scattering of homesteaders, but development of much of that area was slow until the wheat boom of World War I. Many land problems of today can be traced back to the early land policies of the United States Government, which ignored limitation of rainfall and limited water supplies in streams and ground water basins and set a homestead pattern of farm units too small for economic use under semi-arid conditions.

Thus, early-day efforts to obtain quick, rich rewards from the land have handed down to this Region a heritage of declining land conditions and a set of land use practices too often incompatible with sound, long-time husbandry of the soil.

WATERSHED RELATIONSHIPS

Most of the factors affecting water supply have their origin in the use of range and forest lands on each watershed. Accelerated erosion is taking place on more than 90 percent of the range and forested lands of the Region. Over half of these lands are eroding at a moderate to high rate.

At low elevations where annual precipitation is less than five inches, the land surface usually has been fairly stabilized by a gravel or rock cover, although some sandier soils are susceptible to wind erosion. As elevation increases, erosion conditions on lands up to about 6,000 feet are acute because of the wide variation in moisture from year to year and corresponding fluctuation in the quantity of protective vegetation produced. As aggregated surface soils are lost, the less permeable, dispersed subsoils are exposed. Consequently, revegetation of the watershed lands becomes progressively more difficult and increased runoff concentrates to form gullies in the most productive portions--the deep soils of the valleys.

Depletion of vegetation by improper grazing has been the principal cause of frequent floods and a rapidly rising toll of sediment damage in the irrigated areas--two effects of watershed abuse which threaten the existence of a large irrigated acreage in the next generation or two, to say nothing of the economic effect on the ranching industry itself.

Damaging floods have occurred with increasing frequency in all the drainage basins of the Region. For example, before 1920, such floods swept down the Rio Grande on an average of every four and one-half years. Since 1920, they have come every three and one-half years. The increasing sediment load in streams has clogged stream channels, brought on drainage and land leveling problems, and caused damage to irrigation and drainage canals and structures, as well as to land and crops. Most dramatic, perhaps, is the sedimentation of large storage reservoirs of the Region. To illustrate, McMillan Reservoir in southeastern New Mexico, built in the nineties to store flood waters for irrigation, is nearly full of sediment. Alamogordo Reservoir, built in 1937 to take the place of McMillan, is already seriously impaired and will be virtually useless in twenty years more.

The irrigation districts downstream, which depend almost entirely on storage of flood flows too large for the upper valley farmers to divert into their canals, oppose soil conservation measures on watershed lands which would protect all interests from these erosion damages. They fear that any work on the watershed will reduce the amount of water reaching their reservoirs, failing to recognize that the principal sources of water and sediment are not the same. Most of the sediment is produced below 6,000 feet elevations, where precipitation varies from 5 to 12 inches. The high mountain areas, where the bulk of the water originates, produce negligible amounts of sediment.

At the same time, ranchers resent any attempt to restrict the number of cattle or sheep they can graze on watershed lands even though improved range conditions will be of first advantage to them. Since most western

watershed lands are publicly-owned, it is hard to understand why the public generally does not become more awakened and demand action to remedy the cause of sediment and flood problems.

The larger irrigation districts in the lower valleys usually were developed last and compete for water with many small scattered irrigated areas in the upper valleys. Competition for water by growing municipalities, wildlife and recreation interests and new industries adds further complications to the water picture in most basins.

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These preliminary observations should point to the fact that erosion and land use problems of irrigated land, dry farm land, and range and forest watershed lands are closely interrelated. For convenience, however, work of the Soil Conservation Service in the Southwest Region can best be described separately for each major land use division.

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IRRIGATION

Irrigation is essential to farming under the arid and semi-arid conditions which prevail in a large part of the Region, with water, rather than land, the limiting factor in development of irrigation agriculture. Since practically all surface flow has already been allotted, there is little opportunity to put more land under irrigation from that source. Some land, principally in Arizona and New Mexico, is watered by pumps, but most ground-water areas are already over-developed. It is sometimes possible but usually very difficult to transfer water to different lands. So, the importance of conserving the land now under irrigation, as well as the water, becomes immediately apparent if we are to secure maximum utilization of these natural resources. Authoritative estimates show that less than half of the water is actually used to supply crop requirements; the rest is lost through evaporation, deep percolation, and transpiration by unwanted vegetation. Some of the water lost through deep percolation is recovered in return flow; nevertheless, the chief hope for improvement or even maintenance of the present status of irrigation agriculture in this Region lies in saving water now lost.

Existing state laws are not always conducive to efficient use of water. "Beneficial use" is necessary to obtain a right to use the water, but beneficial use is not always clearly defined and inefficient use is frequently condoned. Early downstream rights may require the passage of large flows of water, most of which may be lost in transit. The states of Arizona and Colorado need laws to provide for better use of underground water supplies.

Watershed problems affecting water supply have already been described but it should be pointed out that the "flashy" nature of runoff has created a serious problem for systems which depend upon surface flow alone for their

supply. Most of the small systems, which irrigate about 80 percent of the land in this Region, are in this category. Thus, many storage reservoirs are needed to distribute water throughout the irrigation season. In addition, the job of water conservation involves work on canal systems and on irrigation structures as well as the final distribution and application of water on crop lands.

Almost all of these small irrigation systems are in poor general condition, have less than half their original capacity, and need complete rehabilitation of both canals and structures. Many have been in operation from 50 to 100 years, or more, with inadequate original technical design and minimum maintenance since then. Now, however, modern methods, materials and equipment make rehabilitation practical in most cases. Improved headworks, sluicing and desilting devices are needed, as is education in their proper operation. As erosion on the watersheds has increased, damage from side drainages has become an expensive problem and diversion of side flows, or structures to pass flows over or under the canal are badly needed on most systems. Few of the companies have engineering services available. By making such services available, the Soil Conservation Service has given considerable impetus to system improvement.

Another source of inefficiency has been the multiplicity of canal systems. Consolidation would help save water and increase the efficiency of maintenance and operation, but differing water rights, varying financial conditions of the companies, and human suspicions and jealousies usually make consolidation difficult.

Desire to reduce development costs frequently has led small irrigation companies to use water on less desirable land. Ordinarily, too, poor land is assessed the same as good land, leading farmers to irrigate all land for which they have water, including land that is rough and steep. The Soil Conservation Service encourages permanent pastures and careful irrigation on areas like this to control erosion and obtain more profitable use of the land in accordance with its capabilities.

Improvement of irrigation systems is an essential phase of conservation work for, quite logically, no farmer will make expensive improvements on his place until he has reasonable assurance that he can get water with which to grow good crops. However, the greater opportunity for effecting better use of water lies with the farmers themselves. For this reason, the major portion of the technical services available from the Soil Conservation Service in this Region is utilized on individual units.

Erosion is a serious problem in many irrigated areas, but frequently it goes unnoticed for a time because tillage obliterates the symptoms. Fields laid out on non-erosive irrigation grades will remove this hazard. Lengths of irrigation runs need correlating with the irrigation method used, the size of the head of water available, soil conditions, and the crops to be grown, so that uniform penetration is obtained. This includes precise leveling of the land and construction of ditch structures to control water closely. Most

farms need quantities of inexpensive checks, drops, turnouts, spiles and water measuring devices. Weed control on ditch banks is widely needed. In many places, water is delivered to the farmer in such a small flow that efficient use is impossible. In those cases, small ponds can sometimes store the night flow and provide an adequate head of daytime irrigation and, with certain modifications, such ponds can also produce fish.

Strong winds are common during the growing season in many of the irrigated areas. It is recognized that trees in the form of farmstead and field windbreaks require a certain amount of soil and water for growth, but it is also known that good tree windbreaks of the proper composition of trees and shrubs, properly spaced and located, are of definite value through reductions in wind velocities. The Soil Conservation Service assists in the planning of field windbreaks when the farmer is convinced that they will be of definite value in reducing wind damages. Windbreaks likewise have a definite wildlife value.

After the various physical improvements are made, there still remains a big educational job and the need for farmers to use their knowledge and improvements to the fullest advantage. They need to know capabilities of their soils, the water requirements of various crops, depth of root zone, and soil and moisture relationships. They must learn to judge the available soil moisture and to apply water without wastage. Soil and its fertility and organic content usually are depleted rapidly in irrigated sections. So, fertilizers, green manure crops, and flexible rotations are needed. The right crops at the right time, weed, plant disease and insect control, good cultural practices adapted to the needs of crops and the limitations of the soil, maintaining fertility and organic content--all these are essential to good irrigation farming, save soil and water, and usually bring marked increases in crop yields.

Inefficient distribution systems and wasteful use of water on the land have resulted in drainage and alkali problems which have limited production on or caused abandonment of significant acreages in most irrigation projects. Seepage from storage reservoirs, main irrigation canals and farm laterals, leaky well casings, and improper use of irrigation water all contribute to water table problems.

High water table or waterlogging is not the only result of poor drainage. Soils in arid and semi-arid areas normally contain at least 0.1 percent or one and one-half tons of soluble salts per acre foot. Most irrigation water contains dissolved salts, and if surplus irrigation water cannot drain readily through the soil and out to some channel, these salts eventually will accumulate in the soil to the point where profitable crop production is no longer possible. Control of ground water is an absolute necessity, not only for reclamation of alkali affected lands, but also to insure the permanence of existing irrigated lands. The excessive salts must be leached downward and out of the root zone through natural or artificial drainage.

Drainage of irrigated lands must be based on knowledge of the source and movement of ground water, permeability and stratigraphy of the soils, and the nature of the alkali. Controlling the source of seepage water is essential to effective drainage. Sealing pervious canals and reservoirs with clay, bentonite, concrete or asphalt is usually the most logical means of eliminating seepage but it is costly. In some marshy sites, due to topography or soil type, drainage is not practical. Such areas may be developed and managed to produce muskrats and waterfowl and other wildlife.

The Soil Conservation Service is assisting farmers to control the acreage of irrigated lands affected by high water table and salts and to reclaim as much of the present affected acreage as possible. Such work is essential to a permanent irrigated agriculture. But perhaps 90 percent of the job is yet untouched.

RANGE AND FOREST LANDS

Range and forest watershed lands engage a large share of the attention and efforts of the conservationists of the Southwest Region in their assistance to soil conservation districts. These lands are of special concern because, as has been said, perhaps nowhere else in the country is the use of range and forest lands in the watersheds of such critical importance to the entire economy.

Since sources of data do not distinguish between range and farm livestock, it is impossible to determine accurately the range livestock population. The 1945 agricultural census for the four States indicated that roughly 3,500,000 beef cattle, a little over 6,000,000 sheep and about 250,000 goats subsisted chiefly on range. In addition, some 750,000 dairy cattle and horses make considerable use of range.

More than half the total range area is in federal ownership. A major portion of the federal grazing lands is in the so-called desert zone where public domain predominates, and in the high mountains which are largely national forests. Private ownership, together with lease of State lands, occurs chiefly in the vast intermediate zone. These zones overlap greatly but serve to delineate characteristics of climate, soil, vegetation and type of use which affect the work of range conservation.

The arid "desert" area has annual precipitation of 9 inches or less, high summer temperatures and high evaporation. Present vegetation is principally desert shrub with relict areas of desert grass, formerly widespread but severely depleted during recent generations. The balance of nature is precarious for perennial grasses and they are quickly destroyed by misuse. This zone has elevations up to about 5,000 feet, and it comprises about 28 percent of the Region. Little of the water supplies but much of the sediment in the streams come from this belt.

The intermediate zone has a precipitation range from 10 to 20 inches. Vegetation types include the short grass plains, pinon-juniper, sagebrush, scrub oak and other "browse", and ponderosa pine areas. All these types, under natural conditions, support a good herbaceous cover of grasses adapted to the arid and semi-arid conditions and this zone is the most important one in production of range livestock. Elevations range from 3,800 to 8,000 feet and the zone includes about 62 percent of the Region.

The third zone includes the high mountain areas, has precipitation of 20 to 40 inches, and occupies elevations from 7,500 to more than 14,000 feet above sea level. Practically all the timber lands occur in this zone, but there are also extensive wet and dry meadows and open grass parks. An understory of herbaceous vegetation, suitable for grazing, exists except where forests are too dense to permit its growth. It contains about 10 percent of the total area of the Region and yields a high percentage of the water supply but little of the sediment of southwestern streams.

Virtually all commercial timber production is from high mountain areas in this third zone where annual precipitation is 20 inches or more. The principal tree species are ponderosa pine, lodgepole pine, Engelmann spruce, Douglas fir and white fir. Ponderosa pine makes up the largest percentage, particularly in Arizona and New Mexico. Other species include aspen, cottonwood, limber pine, alpine fir, juniper and pinon.

Most of the forest land is under federal ownership, principally as national forests. Areas within the national forests, state forests, Indian reservations and other small areas in federal ownership are under management, and cutting, in most cases, is carefully regulated. Some of the larger timber owners are showing interest in the management of their holdings on a sustained yield basis. Some of the farmers and ranchers owning woodland areas within soil conservation districts are making use of the technical assistance available to them from the Soil Conservation Service in the management of these areas. Farmers and ranchers as a whole, however, have not shown much interest in the proper management of their woodlands. This is largely because they do not realize their full value. When trees have been sold, it has usually been on a lump-sum or stumpage basis in which the owner received only a small percentage of the actual value of his woodlands.

The importance of timber management can hardly be over-estimated. Irreparable damage through injudicious timber cutting, followed by overgrazing, has already been done to some areas in terms of timber reproduction, loss of soil and increasing flood hazard. Timber cutting in the Southwest offers certain erosion hazards under the best of conditions, but if only mature trees are cut, leaving a few seed trees per acre and all of the straight growing immature trees, a good timber stand can be maintained. Erosion can be prevented by using slash to block skid trails and roads that are no longer needed, where this practice will not cause a fire hazard. If cut-over areas are protected from fire and overgrazing, vegetation of all classes will quickly cover the disturbed soil.

Improper timber cutting, coupled with overgrazing, encourages spread of sage and oak brush, pinon, juniper, mesquite and other species of low value either for grazing or for erosion control. Once they are established, eradication of these species is slow and expensive. Proper management of the land and vegetation is the first step in solution of this important problem in many watershed areas.

Depletion of the grass cover has reduced the available feed for livestock to the point where livestock numbers now carried on southwestern ranges are probably not more than half that of former years. At the time this Region was opened to settlement, there were vast, accumulated reserves of vegetation and no one knew proper grazing rates. Before such rates were known, ranges were stocked on the basis of the reserve productivity. Expansion of the livestock industry was phenomenal and widespread depletion occurred before it could be controlled.

Roads, railroads, trails, lumbering operations, mining, and, in fact, every use by man contributed its share to range depletion. There is no indication that climate or precipitation have changed materially. However, the erratic character of the rainfall has had bearing because range use has often been based on the vegetation produced in more favorable years. This meant damage to the range during drouth periods. Likewise this Region has its full share of uneconomic operating units, resulting in "mining" the range in an effort to stretch resources.

The use pattern and the nature of southwestern ranges make the treatment of erosion different from that in humid regions. The low per-acre income makes it impractical for operators to attempt expensive treatment. The most important treatment and the only one that can be applied to all range land is range management.

Reduced to its simplest terms, range management means adjusting grazing by livestock to the forage which Nature produces. Fortunately management practices such as rotation and deferred grazing which require no large outlay of either labor or materials are generally effective in producing both maximum forage yields and maximum soil conservation. Supplementary treatments like fencing, stock water development, gully control, water spreading and diversions, may serve for erosion control, to facilitate good use of the range, or for both purposes.

Where lands have been depleted by overgrazing or abandoned after unsuccessful cultivation, reestablishment of grass or more desirable species of grass can sometimes be accomplished by conservative grazing and proper handling of livestock. But, if there is an insufficient number of desirable range plants present, artificial revegetation may be the only answer. This requires seeds of adapted species of grasses and legumes and they must be available at reasonable cost. Species used in range reseeding should be capable of producing a permanent usable range pasture and reseeded areas must be protected until well established. Many native grasses and a few introduced species have proved their worth in range revegetation. Some seeds are difficult to collect from native stands but can be produced from farm plantings.

Reseeding of range and farm lands gives the stockman an opportunity to establish range pastures which will provide grazing at seasons when his other range units are unproductive or should be rested. The replacement of poor and undesirable vegetation with desirable range forage plants controls erosion, is of great economic value to the livestock industry, and also aids irrigation interests by keeping sediment out of stream channels, reservoirs and canals.

In addition to grazing and lumbering, range and forest watershed lands have other uses--recreation wildlife production, water supply protection and mining. Many of the complications in range use and management result from the requirements of the multiple uses.

DRY LAND FARMING

Land capability is the most important factor in determining the use that is to be made of land in the dry farm areas of the Region. Unless these lands are farmed with crops and practices adapted to their capabilities, they probably should not be considered as arable lands. The soil erosion hazard is high; its solution is complicated. Most of the land is subject to wind erosion damage unless adequately protected. Even so, soils are not generally the major factor limiting production because they are usually deep and, although low in organic matter, do produce abundantly during wet years.

Precipitation is erratic in most areas with annual extremes of 8 inches or less to more than 40 inches. Seasonal variations are as extreme as the annual. Dry years, when crops which would provide protective residues are hardest to produce, are the years when cover is most needed. And, during wet years when ample residues could be produced, many farmers either remove everything at harvest or graze off the stubble before spring. Then, if blowing starts, they must rely on emergency tillage, a poor substitute for crop residues in controlling wind erosion.

Most of the better dry farm land in the Region falls in Class III where cultivation is considered safe if intensive measures are applied to cope with the hazards of climate. Land in areas where uncertain precipitation makes continuous cultivation questionable, and where special treatment or practices are required for protection against wind erosion, are placed in Class IV. If soil characteristics are unfavorable, the lands are non-arable, placed in Classes V, VI and VII and should be used only for grazing subject to conservation treatments varying from slight to extreme, respectively.

Practically all areas containing Land Classes II (cultivated safely with easily applied conservation practices) and III have two or more generations of farming behind them and farmers there are more easily convinced of the accuracy of land classification than in the newer areas where there is usually considerable Class IV land. A large part of the land on the marginal side of Class IV and in Classes V and VI, although productive in wet years,

constitutes a special wind erosion problem in most areas during years of less than normal precipitation when production of an adequate crop residue cover is most needed and hardest to produce.

Lacking long-time climatological information and cropping history, it is sometimes difficult to know whether land should be in Class IV or in Classes V or VI. On such lands, it is still more difficult to obtain farmer acceptance of land capability classifications because of high yields during wet years and a great tendency to consider wet years as normal and dry years as subnormal. The past five years have been unusually favorable in some areas in both crop yields and prices. Many thousands of acres of good range land have been plowed up and more will probably be plowed until we again experience low yields and prices. Most of this recently plowed land will be abandoned ultimately and will be a liability on the States until it is reclaimed through costly revegetation. The only protection from land speculators and gambling farmers during favorable crop years will be land use regulations imposed and enforced by local people.

As might be expected, water conservation practices are more readily accepted than other conservation practices in the dry farm areas. Contour farming is increasing steadily in all areas. Terracing, both as a water conservation practice on the flatter slopes and as a supporting practice for contour farming on slopes subject to water erosion, is increasing slowly. Obstacles to a rapid increase include difficulty of adjusting large type machinery to terrace farming, inadequate research data to prove the value, and the slowness of establishing grassed waterways. Mechanical stabilization is impractical in most areas and the intervals between effective precipitation are usually so long that establishment of an effective sod cover is slow. Contour farming is recommended for all land except deep, sandy soil where the water intake is rapid and where uneven topography makes the establishment of contours impractical. In these cases, farming across the direction of the prevailing winds is recommended.

Strip cropping, while on the increase in some areas, has not been accepted generally. A pattern of winter wheat, fallow and winter wheat, the fallowed strips alternating with the cropped strips, is proving to be a good practice for both wind and water erosion control in the northern part of the Region where a large portion of the precipitation comes in winter and spring. Farmers generally recognize the value of strip cropping, but object to the practice because their equipment is more adapted to large field operations and would have to be moved from one field to another several times during the year. In the southern part of the Region, where most of the moisture comes in late spring, summer, and early fall, the Soil Conservation Service and state experiment stations advocate a flexible cropping system. This includes the use of fallow, preferably in a strip-crop pattern, only when sub-soil moisture reserves in the fall total less than four inches of stored moisture. When sub-soil moisture is more than four inches, the use of sorghums in strips is recommended. Strip cropping for the protection of non-residue producing crops such as beans is not being used to any great extent. Farmers generally still decline to narrow their strips to the extent necessary for protection--eight rows or less.

Residue production and management should always be the Number One practice for all dry farm land because it is equally valuable for water conservation and water and wind erosion control. As previously noted, the chief obstacles to proper residue management for wind erosion control are economic pressures on the farmer during years of low crop yields, and the fact that lands are still being farmed that yield residue-producing crops only during the more favorable years.

Practically all dry farm land in the Region is now in soil conservation districts. The major problem confronting boards of supervisors in getting soil conservation practices adapted in these districts, however, is that there are still individual farmers not yet ready to acknowledge they are trying to farm some land that should be retired to sod cover.

CONCLUSION

This, then, is the picture of soil and water conservation in the Southwest Region. Nowhere is there greater dependence upon these resources, and nowhere more varied and difficult problems in their conservation. But a good start has been made, and the people of the Region are joining forces with the Soil Conservation Service and other agencies to tackle the job with ever increasing understanding and enthusiasm.

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